



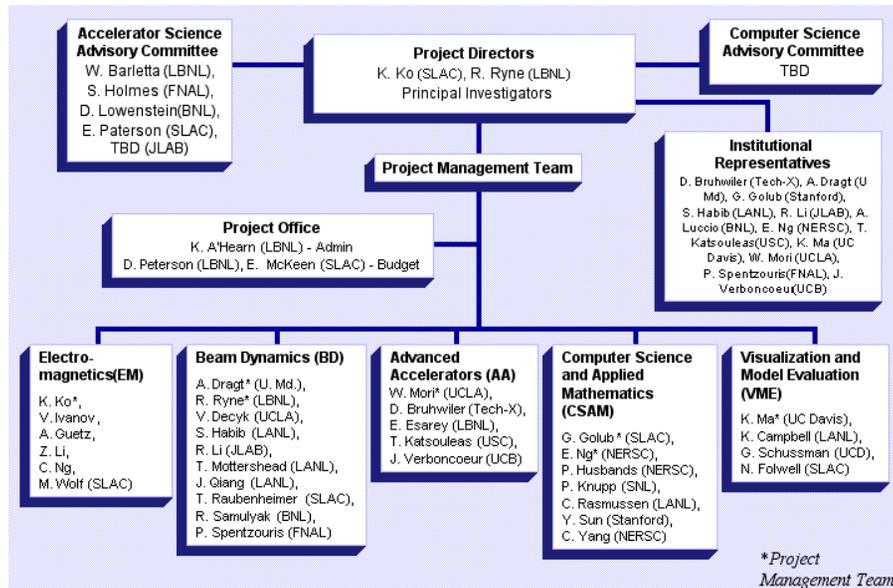
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Advanced Accelerator Simulation Project

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http://www-cpd.fnal.gov/Advanced_Accelerator_Simulation.html

SciDAC Accelerator Modeling Project Org Chart
August 2001



Multi-Institution Collaboration to develop the next generation of beam dynamics modeling tools

SciDAC funded project



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Objectives

- Create Beam Dynamics code with the ability to **model 3-D collective beam effects**
 - Utilize power of **parallel computing**
 - Model future and operating accelerators
- The code should
 - Integrate/utilize **existing packages**
 - Be easily distributable & **portable**
- Model FNAL Booster (space charge expected large)
 - **benchmark** code & help **optimize** machine performance



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Other Tasks

- Act as liaison between FNAL and the collaboration
 - Organize “workshops”
 - Coordinate exchange of information
 - Model collective effects at the TeV
 - ✓ Beam-Beam effects modeled at LBNL & SLAC



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Timeline/Plans

- 3 year SciDAC funding (~\$350k)
 - FY03 second year since funds arrived.
 - FY04 finish development of space-charge code, documentation, make code available. Project wide proposal for **2 year extension**.
 - FY05 and beyond:
 - ⇒ would like to continue involvement with beam modeling
 - ⇒ if the project is extended, will work on development of additional physics capabilities
- ⇒ If **additional manpower** study other machines



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Achievements To Date

- First 3D space-charge code for circular accelerators
 - Re-use existing beam dynamics packages: mxyzptlk & Impact
 - Provide build system and code distribution tools
 - Human interface & standard accelerator lattice description
 - Code **performs x 10 better** than anticipated



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Booster Studies

- Booster required to run **x 4 more protons/hr** for MiniBooNE+Run II, **x 20 when NUMI** turns on
 - Will become bottleneck when NUMI starts
 - **Losses main problem; will lead to longer downtimes**
 - **Booster emittance affects TeV performance**
- Booster losses within first 1ms due to space charge
 - Study and help eliminate effect
- **But first:**
 - Understand instrumentation & validate code

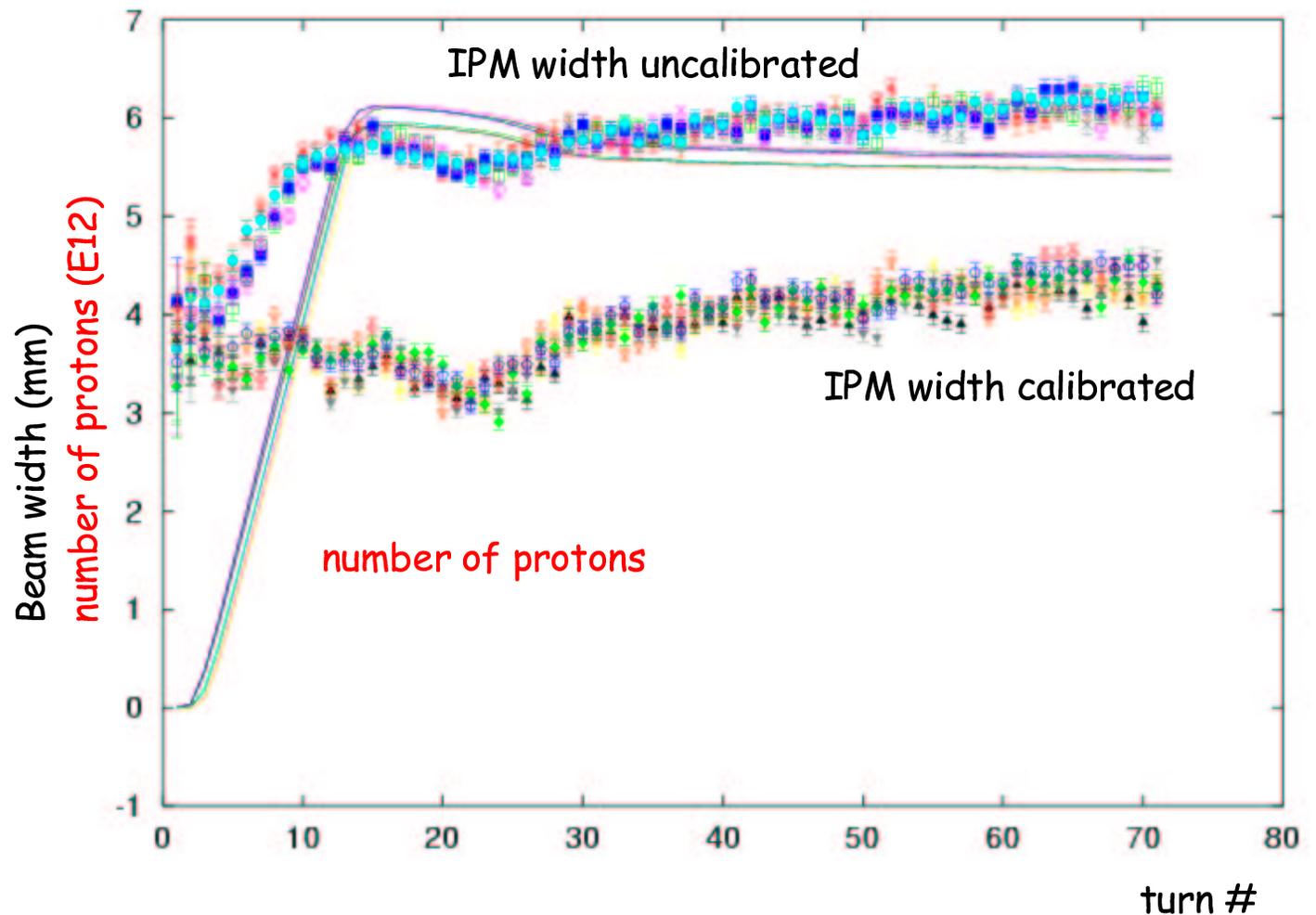


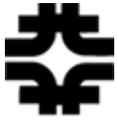
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IPM Calibration

IPM is the only
Booster device
with **turn by
turn resolution**
⇒ **needs to be
calibrated**

Use "flying beam"
technique and
MWPC to **obtain
IPM calibration!**

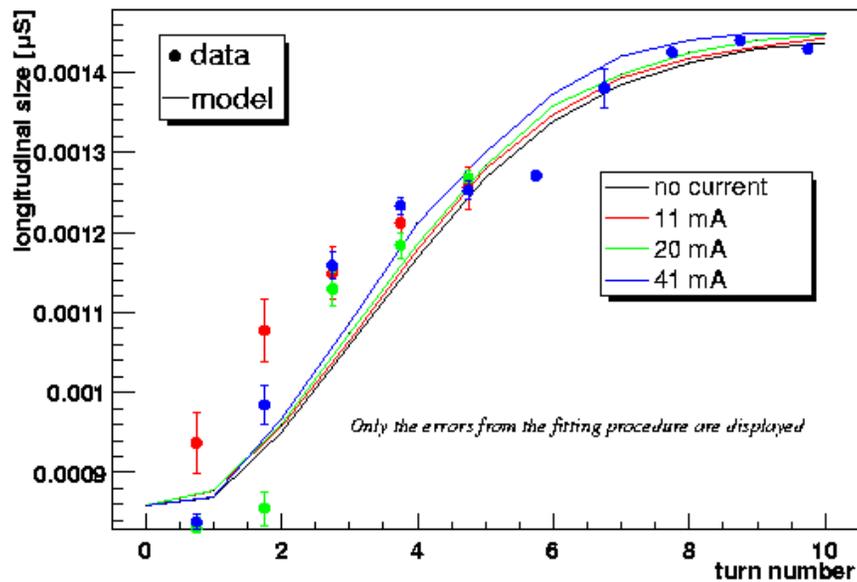




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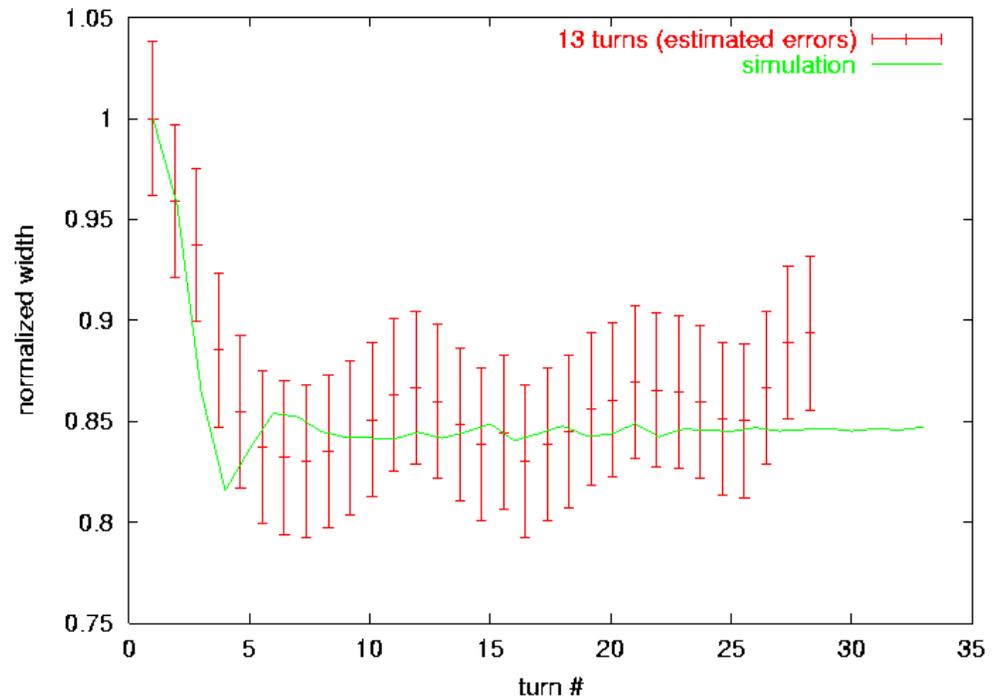
Data (Booster)/Model comparisons

FNAL Booster space-charge modeling and experiment



More studies underway
in collaboration with BD

Model validation effort:
Data/MC comparison, a rare
phenomenon in Beams Physics!



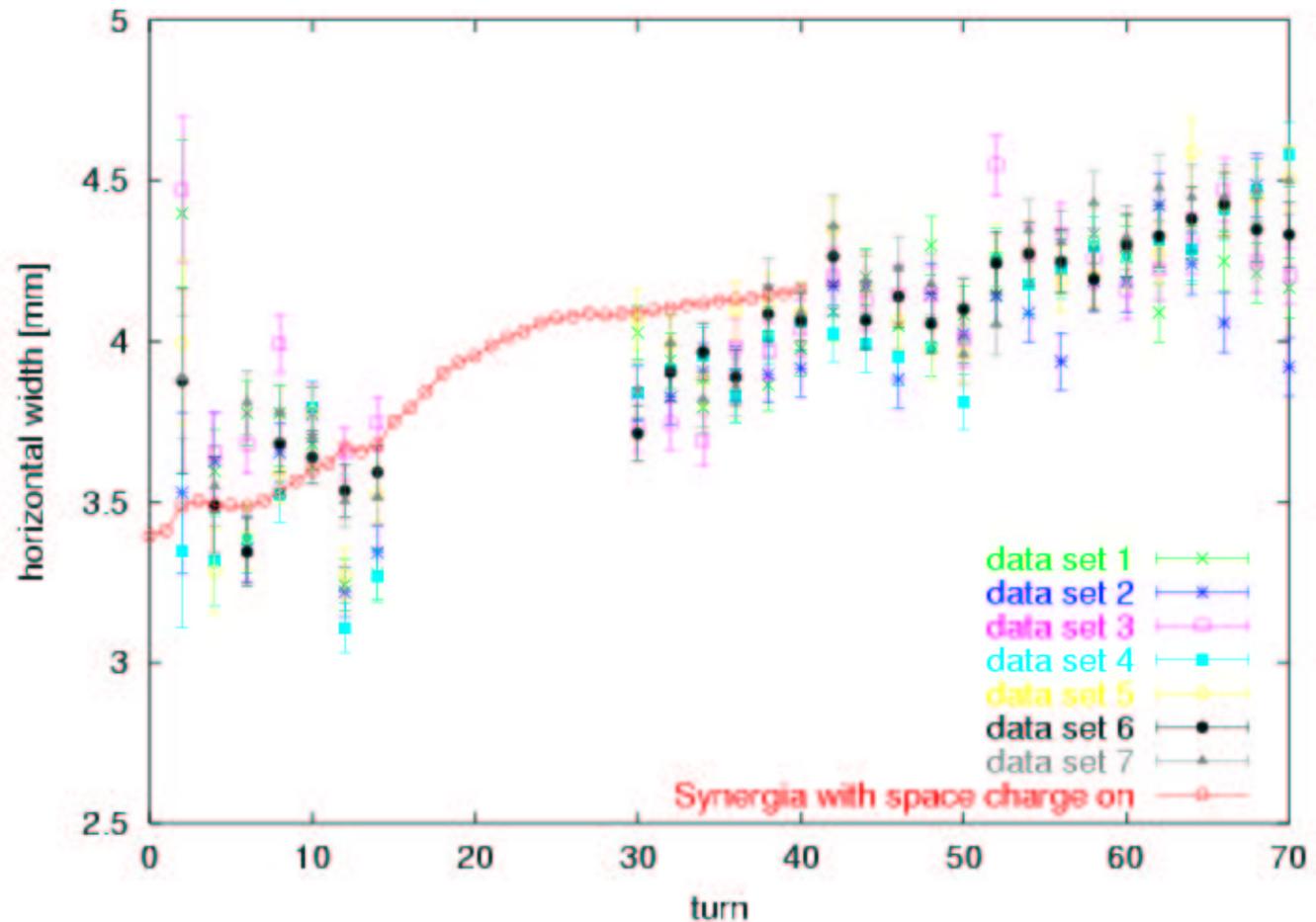


Συnergia

Synergia/data comparisons

11 turns in the machine
~440 mA of current

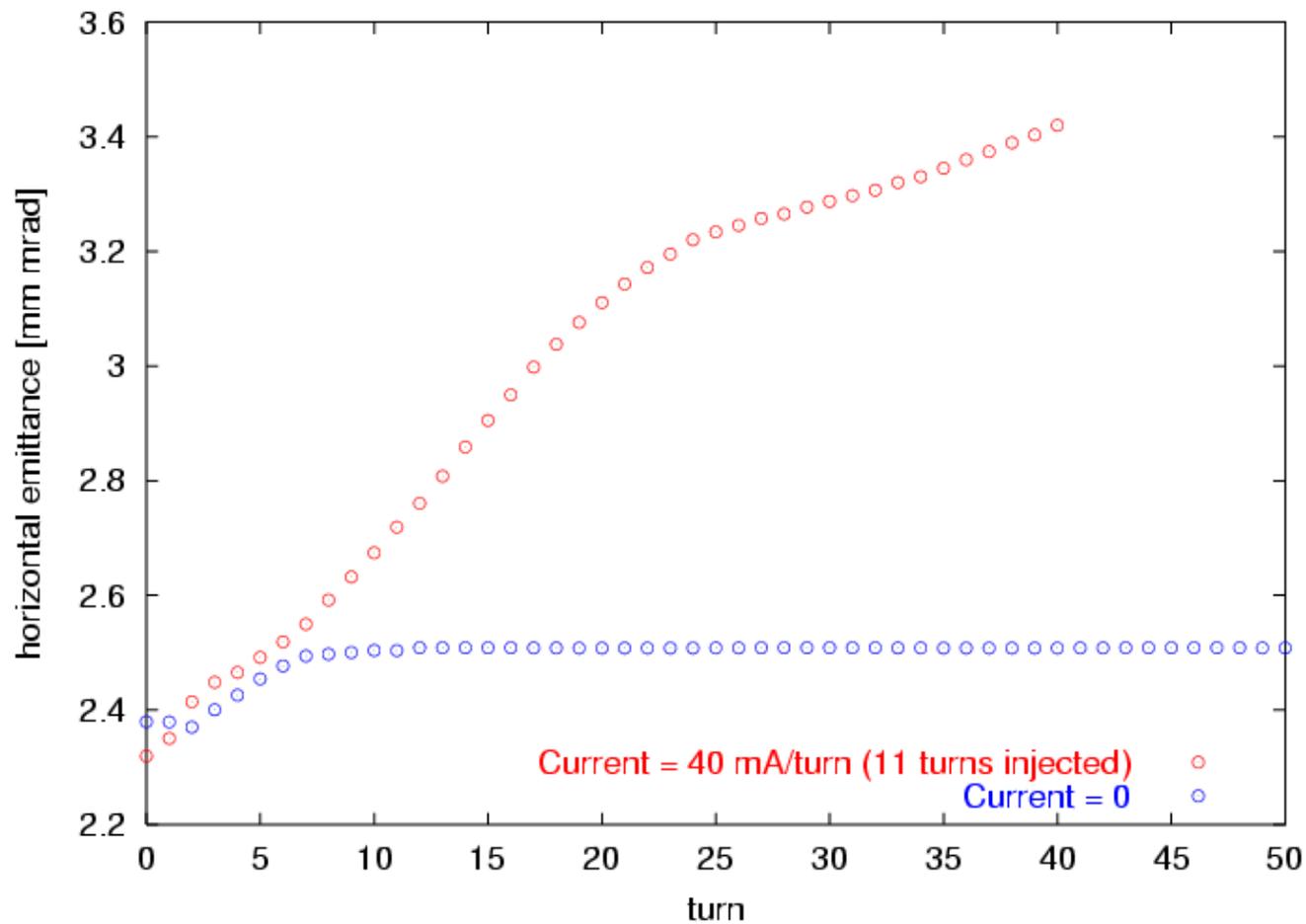
Compare transverse
width from IPMs with
Synergia





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Space charge effects





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Code performance

800 Mhz PIII

Linux cluster, 1.4 Mhz
Athlon, 100 Mb Ethernet
Portland Group compiler
same but Intel compiler

Linux cluster 866 Mhz
PIII with Myrinet

IBM SP with 375 Mhz
POWER3 processors

Modeling 2.7M particles,
with a 65^3 grid for 1
Booster turn

